

deficiency is also noted in the greater part of California, which, by the 10th of June, had caused a severe drought in many sections, although sufficient fell on the west slopes of mountain ranges.

*Heavy Special Rains.*—Dodge City, 24th and 25th, 2.15 inches. Denison, 2nd, 2.07. Duluth, 19th to 21st, 4.30. Fort Sill, 19th and 20th, 2.83. Leavenworth, 16th, 2.40; 31st, 2.30. Omaha, rained more or less every day from the 10th to the 20th, inclusive, during which time 4.57 inches fell; 31st, 2.24. St. Paul, 30th and 31st, 3.31. St. Augustine, Fla., 27th, 10 a. m. to 28th 7 a. m., 6.50. Fort Snelling, Minn., 20th, 3.34; 30th, 4.30; 31st, 5.12. Golden, Col., 2nd, 5th and 6th, snow-fall 10 $\frac{1}{2}$ . Belvidere, Ill., 20th, 1.03 rain-fall in twenty minutes. Manhattan, Kan., 19th 3 inches during the night. Creswell, Kan., 12th 3 inches; 18th, 3.23. Austin, Tex., 6th, 3 inches in the morning.

*Small Monthly Rain-falls.*—The following stations report less than 0.50 inches of rain during the month: San Diego, 43; San Francisco, 18; Eagle Pass, 43; Florence, 31; Tucson and Maricopa Wells, 41; Sanguen, 26; Yuma, 06; Salinas City, Cal., 0.20; Forsyth, Ga., 0.45; Palermo, N. Y., 0.40; Nile, N. Y., 0.45; Ruggles, Ohio, 0.25; Hudson, Ohio, 0.25; Salem, Ohio, 0.35; Franklin, Penn., 0.47; Tusculum, Tex., 0.51. (the smallest for many years;) Strafford, Vt., 0.4.

*Large Monthly Rain-falls.*—Rain to the amount of seven inches or more fell during the month at the following stations: Duluth and Fort Sill, 7.24; Leavenworth, 8.67; Omaha, 8.62; St. Augustine, Fla., 9.95; Fort Snelling, Minn., 14.48; Creswell, Kan., 11.81; Segwick, Kan., 16.37; Springfield, Mo., 8.55; Clear Creek, Neb., 10.87; Howard, Neb., 10.05.

*Droughts.*—Droughts, injurious to vegetation, have been reported as follows: Cal., droughts in the interior, but abundant rains on the coast side of the mountains. Fla., severe droughts, but crop not yet injured. Ill., strawberry crop shortened one-third by drought. Southern Ind., vegetation suffering for want of rain. Ohio, very dry, corn and oats need rain. Tenn., smallest rain-fall for many years, gardens are suffering. S. Car., (York Co.) no rain throughout the month; crops all suffering.

*Hail-storms.*—Special notes of hail-storms have been received from 93 stations on 29 days, distributed as follows: On the 1st, N. Y.; 2nd, Kan.; 3rd, Tex.; 4th, N. Y.; 5th, Tex., S. C., Tenn., Mont.; 6th, Tex., Fla.; 7th, Ala., Tex.; 8th, S. C.; 9th, Nev., N. C.; 11th, Nev., Utah, Tex.; 12th, Tex.; 14th, Dak., N. C.; 15th, Minn., Neb., Tenn.; 16th, Cal., Col., N. Y.; 17th, Iowa, Mass., Neb.; 18th, Neb., Cal., Conn., N. Y., R. I., Vt.; 19th, Dak., Tex.; 20th, Nev., Ind.; 21st, Nev., Ill., Md., N. J., Penn., Tenn., W. Va.; 22nd, Nev., Del., N. J., Penn., Neb., Tex.; 24th, Tex., N. Y.; 25th, N. J., N. Y., Col.; 26th, N. J., Penn.; 27th, Md., Neb., Tex.; 28th, Dak., Neb. Tex.; 29th, Ill., Kan.; Col., Dak., Neb.; 31st, Dak., Kan., Utah, Iowa, Minn., Mo., Neb., Ill.

*Large Hail-stones.*—Among the cases of large hail-storms are the following: 3rd, terrific and destructive storm near Mason, Tex., hail as large as a man's hand, crushing crops and killing thousands of sheep. 4th, near Mendon, Mass. 7th, in Sabine county, Texas, 2.6 in. diameter, 3 to 4 in. long. 14th, at Bismarck, Dak., hail-stones 1.7 in. long, 1 in. wide, (see Loomis, p. 131, fig. 54.) 18th, the local storms and tornadoes of the 18th, elsewhere described, were accompanied by large hail, as follows: Cranston, R. I., 1 in. in diameter; Pascoag, R. I., 1 $\frac{1}{4}$  in.; Brookfield, Mass., 1 in.; Webster, Mass., 3 in.; Oxford, Mass., 4 in. Bennington, Vt., 5 in. 27th, 22 miles north of Mason, Texas, 3 to 4 in. diameter, crushing through roofs; at Fort McKavett, 1 in. diameter, very destructive.

*Snow-fall.*—Falls of snow have been reported as follows: 1st, Mich., Ohio, Wy., Ind., N. Y., W. Va., Penn., Mon.; 2nd, Wy., Col., N. Y., Va.; 3rd, Wy., Va., Mich.; 4th, Mon.; 5th, Wy., Col., Mon.; 6th, Wy., Col.; 7th, Mon.; 8th, Mon.; 9th, W. Va., Mon.; 10th, Me., Vt.; 12th, Wy.; 17th, Utah, Mon.; 18th, Utah; 19th, Wy., N. M.; 23rd, Nev.; 24th, N. J., N. Y., Mass., (4 inches in Berkshire county;) 29th, Nev.; 30th, Wy.; 31st, Wy., Mon.

*Rainy days.*—The number of days during the month on which rain has fallen, as reported by the Signal Service observers, ranges from 5 to 17 in New England; 9 to 14 in the Middle Atlantic States; 5 to 14 in the South Atlantic States; 3 to 13 in the Gulf States; 5 to 15 in the Ohio valley and Tennessee; 6 to 11 in the Lower Lake region; 4 to 11 in the Upper Lake region; 9 to 27 in the Northwest; 8 to 22 at the Rocky Mountain stations; 3 in Arizona; 10 at San Diego; 1 at San Francisco; and 16 at Portland, Oregon.

*Cloudy days.*—The number of cloudy days during the month, as reported by the voluntary and army surgeon observers, ranges as follows: New England, 5 to 12; Middle States, 3 to 13; South Atlantic States, 0 to 8; Gulf States, 0 to 10; Tennessee and the Ohio valley, 2 to 13; Upper Lake region, 1 to 9; Northwest, 2 to 18; Colorado, Wyoming, Utah and Idaho, 4 to 9; California, 1 and 2.

## RELATIVE HUMIDITY.

The average relative humidity for the month ranges from 69 to 75 per cent. at the stations on the immediate coast of North Carolina, New Jersey and New England; other stations in the Atlantic States,

54 to 69; Gulf States, 53 to 73; Ohio valley and Tennessee, 56 to 62; Lake region, 54 to 68; Northwest, 52 to 72; Rocky Mountain stations, (excepting Pike's Peak,) 33 to 61; Pacific coast, 65 to 73.

## WINDS.

The prevailing directions of the wind are shown by the arrows on chart No. II, from which it will be seen that the south and southeast winds have corresponded throughout the interior of the country very clearly to the distribution of barometric pressure.

*Total movements.*—Largest: Pike's Peak, 17,483; Dodge City, 11,998; Cape Lookout, 11,598; Cape May, 10,357; Breckinridge, 10,301. Smallest: Portland, Or., 2,394; Lynchburg, 2,569; Shreveport, 2,771; Augusta, 2,955.

*Highest winds.*—The highest velocities in miles per hour have been: 126 at Mt. Washington; 84 at North Platte; 70 at Pike's Peak; 60 at Cape Henry and Duluth.

*Local storms, tornadoes, &c.*, are reported as follows: 6th, a tornado passed over St. Marks, Fla., at 1:50 p. m., demolishing several houses, chimneys, &c.; another occurred in Sabine, Tex. 14th, a whirlwind at Eastport, Me. 18th, tornadoes at St. Hyppolite, Can., and near Quebec. The tornado of the 18th, passing from Saratoga co., N. Y., southeastward into Bennington co., Vt., was especially destructive at Argyle and Cambridge, N. Y., and Bennington co., Vt.; the average width of destructive winds and hail is said to have been less than 2 miles, and its length about 50 miles; hail-stones of 5, 6 and 8 inches in circumference and weighing 4 ounces were picked up, and the very heavy rain accompanying it did additional damage; it began about 1 p. m., and probably ended about 3 p. m. in Vt. 20th, Marion, Ind. and Blackearth, Wis., severe storms. 21st, Key West, Fla. water-spout half mile NW. of station. 22nd, Wytheville, Va., severe wind-storm. 26th, Boerne, Texas, violent tornado. Sand-storm at Yuma, A. T., on the 28th, and "terrific" sand-storm on the 29th. On the 16th to 19th the unusual occurrence is noted of a very heavy "Kona" storm and rain over the Sandwich Islands; heavy snow fell on the mountains, and a large water-spout was observed at Honolulu. (The "Kona" is a strong northerly wind, interrupting the regular NE. trade, and usually preceding a hurricane.) 30th, St. Paul, Minn., violent storm.

## VERIFICATIONS.

*Indications.*—The detailed comparison of the tri-daily weather Indications with the telegraphic weather reports for the succeeding 24 hours shows a general percentage of omissions of 0.1 per cent., and of verifications of 85.9 per cent. Out of 3,713 predictions, 2,719, or 73.3 per cent., have been fully verified; 292, or 7.9 per cent., have been three-fourths verified; 459, or 12.4 per cent., have been one-half verified; 83, or 2.3 per cent., one-fourth verified; 160, or 4.4 per cent., have failed. The percentages for the four elements have been: Weather, 94.4; Wind, 87.5; Temperature, 84.1; Barometer, 77.6. The percentages of verifications by geographical districts have been: New England, 84.7; Middle Atlantic States, 87.0; South Atlantic States, 85.4; East Gulf States, 88.8; West Gulf States, 88.3; Lower Lakes, 86.4; Upper Lakes, 82.5; Tennessee and the Ohio valley, 87.9; Upper Mississippi valley, 83.7; Lower Missouri valley, 83.8.

*Cautionary Signals.*—During the month 83 Cautionary Signals have been displayed at stations on the Gulf and Atlantic coasts and the Lakes. Of these, 49, or 59 per cent., were justified by subsequent high winds within one hundred miles of the stations where they were displayed, and 34, or 41 per cent., were not justified so far as known. Fifty-one instances of high winds, when no signals were displayed, have also been reported from these stations. Telegraphic communication with the North Carolina coast stations has been interrupted during the month.

## NAVIGATION.

*Stages of Water.*—In the table on chart No. III is shown the highest and lowest readings on the river-gauges for the month. It will be seen that the lowest water in the Missouri and the extreme upper portion of the Mississippi occurred about the middle of the month, after which time these rivers rose until they reached their highest readings, at the close of the month. The lower portion of the Mississippi, as also the Ohio and its tributaries, and the Red river, all reached their lowest readings on the last day of the month. The Mississippi was slightly above the danger-line at Vicksburg from the 1st to the 23rd. At Keokuk, on the 28th, navigation was obstructed by the very low stage of water; also at Pittsburgh on the 29th. At Cambridge, Texas, on the 21st, water was very high in the Red river. At Indianola, on the 16th, tide was 8 feet higher than usual. At Leavenworth, destructive freshet on the 18th, and river very high on 30th. At Creswell, Marion county, Kan., highest flood for many years. At Sedgwick, Kan., on the 19th, river rose 23 ft. in 24 hours. At Hutchinson, and other towns in eastern Kansas, destructive freshet on the 20th, and subsequently.